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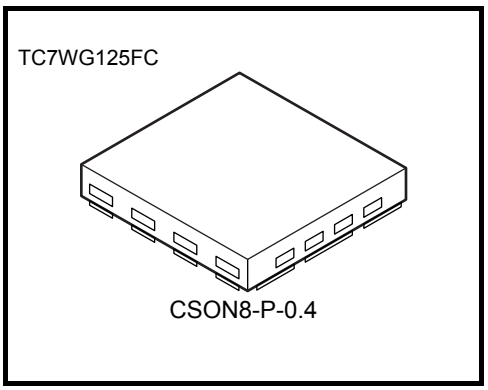
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7WG125FC

Dual Bus Buffer with 3-STATE Output

## Features

- High-level output current: $I_{OH}/I_{OL}$ = ±8 mA (min) at $V_{CC}$ = 3 V
- High-speed operation: $t_{pd}$ = 2.5 ns (typ.) at $V_{CC}$ = 3.3 V,15pF
- Operating voltage range: $V_{CC}$ = 0.9~3.6 V
- 5.5-V tolerant inputs
- 3.6-V power down protection outputs




Weight: 0.002 g (typ.)

## Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Value | Unit |
|---|---|---|---|
| Power supply voltage | $V_{CC}$ | −0.5~4.6 | V |
| DC input voltage | $V_{IN}$ | −0.5~7.0 | V |
| DC output voltage | $V_{OUT}$ | −0.5~4.6 (Note 1) | V |
| | | −0.5~$V_{CC}$ + 0.5 (Note 2) | |
| Input diode current | $I_{IK}$ | −20 | mA |
| Output diode current | $I_{OK}$ | −20 (Note 3) | mA |
| DC output current | $I_{OUT}$ | ±25 | mA |
| DC $V_{CC}$/GND current | $I_{CC}$ | ±100 | mA |
| Power dissipation | $P_D$ | 150 (Note 4) | mW |
| Storage temperature | $T_{stg}$ | −65~150 | °C |

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

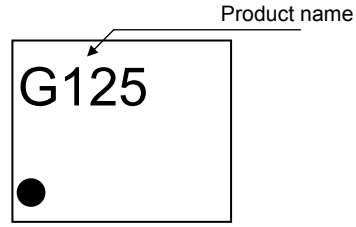
Note 1: $V_{CC}$ = 0 V

Note 2: High or Low State.
$I_{OUT}$ absolute maximum rating must be observed.

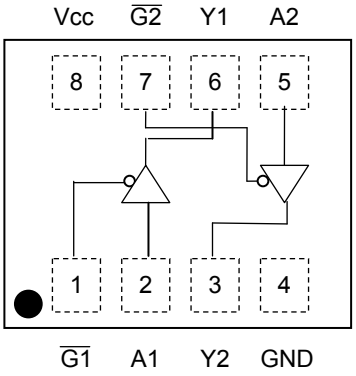
Note 3: $V_{OUT}$ < GND

Note 4: Mounted on an FR4 board.
(25.4 mm × 25.4 mm × 1.6 t, Cu Pad: 11.56 $mm^2$)

## Marking




## Pin Assignment ( top view )

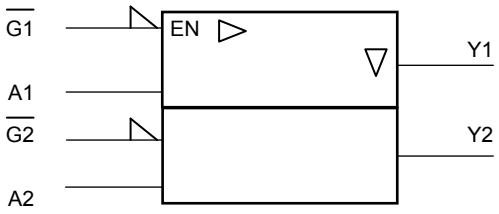


## Truth Table

| Inputs | | Outputs |
|---|---|---|
| $\overline{G}$ | A | Y |
| H | X | Z |
| L | L | L |
| L | H | H |

X: Don't Care
Z: High impedance

## IEC Logic Symbol




## Operating Ranges

| Characteristics | Symbol | Value | | Unit |
|---|---|---|---|---|
| Power supply voltage | $V_{CC}$ | 0.9~3.6 | | V |
| Input voltage | $V_{IN}$ | 0~5.5 | | V |
| Output voltage | $V_{OUT}$ | 0~3.6 | (Note 5) | V |
| | | 0~$V_{CC}$ | (Note 6) | |
| Output Current | $I_{OH}/I_{OL}$ | ±8.0 | (Note 7) | mA |
| | | ±4.0 | (Note 8) | |
| | | ±3.0 | (Note 9) | |
| | | ±1.7 | (Note 10) | |
| | | ±0.3 | (Note 11) | |
| | | ±0.02 | (Note 12) | |
| Operating temperature | $T_{opr}$ | −40~85 | | °C |
| Input rise and fall time | dt/dV | 0~10 | (Note 13) | ns/V |

Note 5: $V_{CC}$ = 0 V

Note 6: High or Low state.

Note 7: $V_{CC}$ = 3.0~3.6 V

Note 8: $V_{CC}$ = 2.3~2.7 V

Note 9: $V_{CC}$ = 1.65~1.95 V

Note 10: $V_{CC}$ = 1.4~1.6 V

Note 11: $V_{CC}$ = 1.1~1.3 V

Note 12: $V_{CC}$ = 0.9 V

Note 13: $V_{IN}$ = 0.8~2.0 V, $V_{CC}$ = 3.0 V

## Electrical Characteristics

## DC Characteristics

| Characteristics | | Symbol | Test Condition | | $V_{CC}$ (V) | Ta = 25°C Min | Ta = 25°C Typ. | Ta = 25°C Max | Ta = −40~85°C Min | Ta = −40~85°C Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Input voltage | High level | $V_{IH}$ | — | | 0.9 | $V_{CC}$ | — | — | $V_{CC}$ | — | V |
| | | | | | 1.1~1.3 | $V_{CC}$ × 0.7 | — | — | $V_{CC}$ × 0.7 | — | |
| | | | | | 1.4~1.6 | $V_{CC}$ × 0.65 | — | — | $V_{CC}$ × 0.65 | — | |
| | | | | | 1.65~1.95 | $V_{CC}$ × 0.65 | — | — | $V_{CC}$ × 0.65 | — | |
| | | | | | 2.3~2.7 | 1.7 | — | — | 1.7 | — | |
| | | | | | 3.0~3.6 | 2.0 | — | — | 2.0 | — | |
| | Low level | $V_{IL}$ | — | | 0.9 | — | — | GND | — | GND | |
| | | | | | 1.1~1.3 | — | — | $V_{CC}$ × 0.3 | — | $V_{CC}$ × 0.3 | |
| | | | | | 1.4~1.6 | — | — | $V_{CC}$ × 0.35 | — | $V_{CC}$ × 0.35 | |
| | | | | | 1.65~1.95 | — | — | $V_{CC}$ × 0.35 | — | $V_{CC}$ × 0.35 | |
| | | | | | 2.3~2.7 | — | — | 0.7 | — | 0.7 | |
| | | | | | 3.0~3.6 | — | — | 0.8 | — | 0.8 | |
| Output voltage | High level | $V_{OH}$ | $V_{IN}$ = $V_{IL}$ or $V_{IH}$ | $I_{OH}$ = −0.02 mA | 0.9 | 0.75 | — | — | 0.75 | — | V |
| | | | | $I_{OH}$ = −0.3 mA | 1.1~1.3 | $V_{CC}$ × 0.75 | — | — | $V_{CC}$ × 0.75 | — | |
| | | | | $I_{OH}$ = −1.7 mA | 1.4~1.6 | $V_{CC}$ × 0.75 | — | — | $V_{CC}$ × 0.75 | — | |
| | | | | $I_{OH}$ = −3.0 mA | 1.65~1.95 | $V_{CC}$ -0.45 | — | — | $V_{CC}$ -0.45 | — | |
| | | | | $I_{OH}$ = −4.0 mA | 2.3~2.7 | 2.0 | — | — | 2.0 | — | |
| | | | | $I_{OH}$ = −8.0 mA | 3.0~3.6 | 2.48 | — | — | 2.48 | — | |
| | Low level | $V_{OL}$ | $V_{IN}$= $V_{IL}$ | $I_{OL}$ = 0.02 mA | 0.9 | — | — | 0.1 | — | 0.1 | |
| | | | | $I_{OL}$ = 0.3 mA | 1.1~1.3 | — | — | $V_{CC}$ × 0.25 | — | $V_{CC}$ × 0.25 | |
| | | | | $I_{OL}$ = 1.7 mA | 1.4~1.6 | — | — | $V_{CC}$ × 0.25 | — | $V_{CC}$ × 0.25 | |
| | | | | $I_{OL}$ = 3.0 mA | 1.65~1.95 | — | — | 0.45 | — | 0.45 | |
| | | | | $I_{OL}$ = 4.0 mA | 2.3~2.7 | — | — | 0.4 | — | 0.4 | |
| | | | | $I_{OL}$ = 8.0 mA | 3.0~3.6 | — | — | 0.4 | — | 0.4 | |
| Input leakage current | | $I_{IN}$ | $V_{IN}$ = 0~5.5V | | 0~3.6 | — | — | ±0.1 | — | ±1.0 | μA |
| 3-state output off-state current | | $I_{OZ}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$<br>$V_{OUT}$ = 0~3.6V | | 0.9~3.6 | — | — | 1.0 | — | 10.0 | μA |
| Power off leakage current | | $I_{OFF}$ | $V_{IN}$ = 5.5V<br>or $V_{OUT}$ = 3.6V | | 0.0 | — | — | 1.0 | — | 10.0 | μA |
| Quiescent supply current | | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND | | 3.6 | — | — | 1.0 | — | 10.0 | μA |

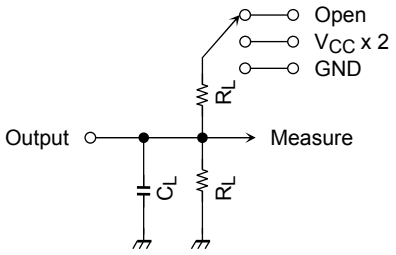
## AC Characteristics (Input: $t_r = t_f = 3$ ns)

| Characteristics | Symbol | Test Condition | | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | Min | Typ. | Max | Min | Max | |
| Propagation delay time | $t_{pLH}$ $t_{pHL}$ | $C_L$ = 10 pF, $R_L$ = 1 MΩ | 0.9 | — | 18.3 | — | — | — | ns |
| | | | 1.1~1.3 | — | 9.4 | 18.4 | 1.0 | 34.9 | |
| | | | 1.4~1.6 | — | 5.5 | 8.5 | 1.0 | 10.7 | |
| | | | 1.65~ 1.95 | — | 4.2 | 6.2 | 1.0 | 6.7 | |
| | | | 2.3~2.7 | — | 2.8 | 3.9 | 1.0 | 4.4 | |
| | | | 3.0~3.6 | — | 2.3 | 3.1 | 1.0 | 3.7 | |
| | | $C_L$ = 15 pF, $R_L$ = 1 MΩ | 0.9 | — | 21.2 | — | — | — | |
| | | | 1.1~1.3 | — | 10.7 | 21.5 | 1.0 | 38.0 | |
| | | | 1.4~1.6 | — | 6.1 | 9.3 | 1.0 | 11.9 | |
| | | | 1.65~ 1.95 | — | 4.7 | 6.9 | 1.0 | 7.1 | |
| | | | 2.3~2.7 | — | 3.1 | 4.4 | 1.0 | 5.0 | |
| | | | 3.0~3.6 | — | 2.5 | 3.4 | 1.0 | 3.9 | |
| | | $C_L$ = 30 pF, $R_L$ = 1 MΩ | 0.9 | — | 30.5 | — | — | — | |
| | | | 1.1~1.3 | — | 14.9 | 30.0 | 1.0 | 58.1 | |
| | | | 1.4~1.6 | — | 8.2 | 13.2 | 1.0 | 16.6 | |
| | | | 1.65~ 1.95 | — | 6.1 | 9.2 | 1.0 | 9.9 | |
| | | | 2.3~2.7 | — | 4.1 | 5.7 | 1.0 | 6.1 | |
| | | | 3.0~3.6 | — | 3.4 | 4.4 | 1.0 | 4.8 | |
| Output enable time | $t_{pZL}$ $t_{pZH}$ | $C_L$ = 10 pF, $R_L$ = 100 kΩ | 0.9 | — | 24.0 | — | — | — | ns |
| | | $C_L$ = 10 pF, $R_L$ = 5 kΩ | 1.1~1.3 | — | 11.8 | 22.5 | 1.0 | 35.8 | |
| | | | 1.4~1.6 | — | 6.8 | 10.4 | 1.0 | 12.0 | |
| | | | 1.65~ 1.95 | — | 5.1 | 7.3 | 1.0 | 8.1 | |
| | | | 2.3~2.7 | — | 3.4 | 4.6 | 1.0 | 5.3 | |
| | | | 3.0~3.6 | — | 2.5 | 3.4 | 1.0 | 3.9 | |
| | | $C_L$ = 15 pF, $R_L$ = 100 kΩ | 0.9 | — | 26.6 | — | — | — | |
| | | $C_L$ = 15 pF, $R_L$ = 5 kΩ | 1.1~1.3 | — | 13.0 | 25.0 | 1.0 | 41.9 | |
| | | | 1.4~1.6 | — | 7.4 | 11.4 | 1.0 | 13.4 | |
| | | | 1.65~ 1.95 | — | 5.5 | 7.9 | 1.0 | 8.5 | |
| | | | 2.3~2.7 | — | 3.7 | 4.9 | 1.0 | 5.5 | |
| | | | 3.0~3.6 | — | 3.0 | 4.1 | 1.0 | 4.6 | |
| | | $C_L$ = 30 pF, $R_L$ = 100 kΩ | 0.9 | — | 36.4 | — | — | — | |
| | | $C_L$ = 30 pF, $R_L$ = 5 kΩ | 1.1~1.3 | — | 17.9 | 35.8 | 1.0 | 59.1 | |
| | | | 1.4~1.6 | — | 9.8 | 15.3 | 1.0 | 17.8 | |
| | | | 1.65~ 1.95 | — | 7.2 | 10.5 | 1.0 | 11.2 | |
| | | | 2.3~2.7 | — | 4.5 | 5.9 | 1.0 | 6.6 | |
| | | | 3.0~3.6 | — | 3.6 | 4.6 | 1.0 | 5.3 | |

| Characteristics | Symbol | Test Condition | | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | Min | Typ. | Max | Min | Max | |
| Output disable time | $t_{pLZ}$ $t_{pHZ}$ | $C_L$ = 10 pF, $R_L$ = 100 kΩ | 0.9 | — | 168.6 | — | — | — | ns |
| | | $C_L$ = 10 pF, $R_L$ = 5 kΩ | 1.1~1.3 | — | 9.5 | 18.4 | 1.0 | 25.2 | |
| | | | 1.4~1.6 | — | 7.5 | 9.5 | 1.0 | 10.6 | |
| | | | 1.65~ 1.95 | — | 7.1 | 8.7 | 1.0 | 9.6 | |
| | | | 2.3~2.7 | — | 6.8 | 7.9 | 1.0 | 8.8 | |
| | | | 3.0~3.6 | — | 6.5 | 7.5 | 1.0 | 8.4 | |
| | | $C_L$ = 15 pF, $R_L$ = 100 kΩ | 0.9 | — | 201.8 | — | — | — | |
| | | $C_L$ = 15 pF, $R_L$ = 5 kΩ | 1.1~1.3 | — | 10.5 | 19.8 | 1.0 | 27.6 | |
| | | | 1.4~1.6 | — | 9.0 | 10.4 | 1.0 | 12.3 | |
| | | | 1.65~ 1.95 | — | 8.5 | 9.7 | 1.0 | 10.6 | |
| | | | 2.3~2.7 | — | 7.9 | 8.8 | 1.0 | 10.3 | |
| | | | 3.0~3.6 | — | 7.6 | 8.3 | 1.0 | 9.5 | |
| | | $C_L$ = 30 pF, $R_L$ = 100 kΩ | 0.9 | — | 251.5 | — | — | — | |
| | | $C_L$ = 30 pF, $R_L$ = 5 kΩ | 1.1~1.3 | — | 14.1 | 23.8 | 1.0 | 31.9 | |
| | | | 1.4~1.6 | — | 13.5 | 14.5 | 1.0 | 16.0 | |
| | | | 1.65~ 1.95 | — | 12.7 | 14.3 | 1.0 | 15.0 | |
| | | | 2.3~2.7 | — | 12.2 | 14.1 | 1.0 | 14.7 | |
| | | | 3.0~3.6 | — | 11.9 | 13.8 | 1.0 | 14.4 | |
| Input capacitance | $C_{IN}$ | — | 3.6 | — | 3 | — | — | — | pF |
| Power dissipation capacitance | $C_{PD}$ | (Note 14) | 0.9 ~ 3.6 | — | 10 | — | — | — | pF |

Note 14: $C_{PD}$ is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.
Average operating current can be obtained by the equation:
$I_{CC\ (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$

## AC Characteristics Measurement Circuit




| Characteristics | Switch |
|---|---|
| $t_{pLH}$, $t_{pHL}$ | Open |
| $t_{pLZ}$, $t_{pZL}$ | $V_{CC}$ x 2 |
| $t_{pHZ}$, $t_{pZH}$ | GND |

**Figure1 $t_{pLH}$, $t_{pHL}$**

## AC Waveforms

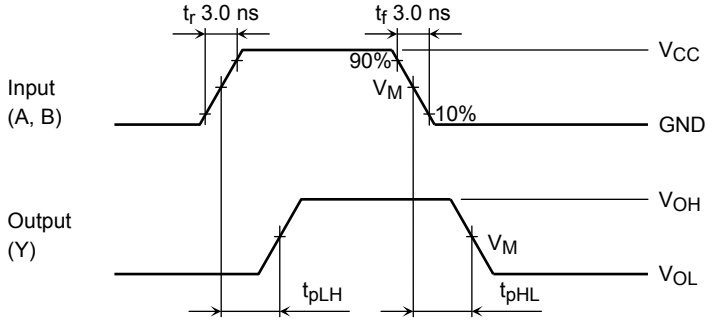



**Figure2 $t_{pLH}$, $t_{pHL}$**

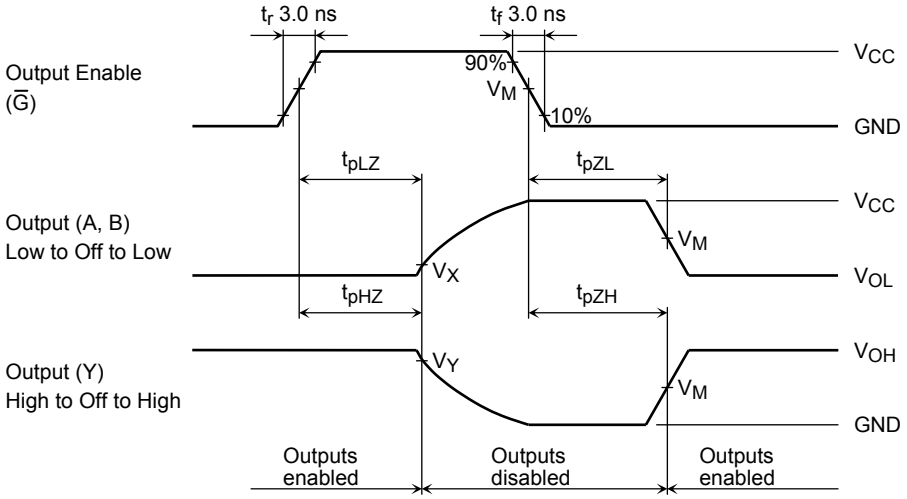
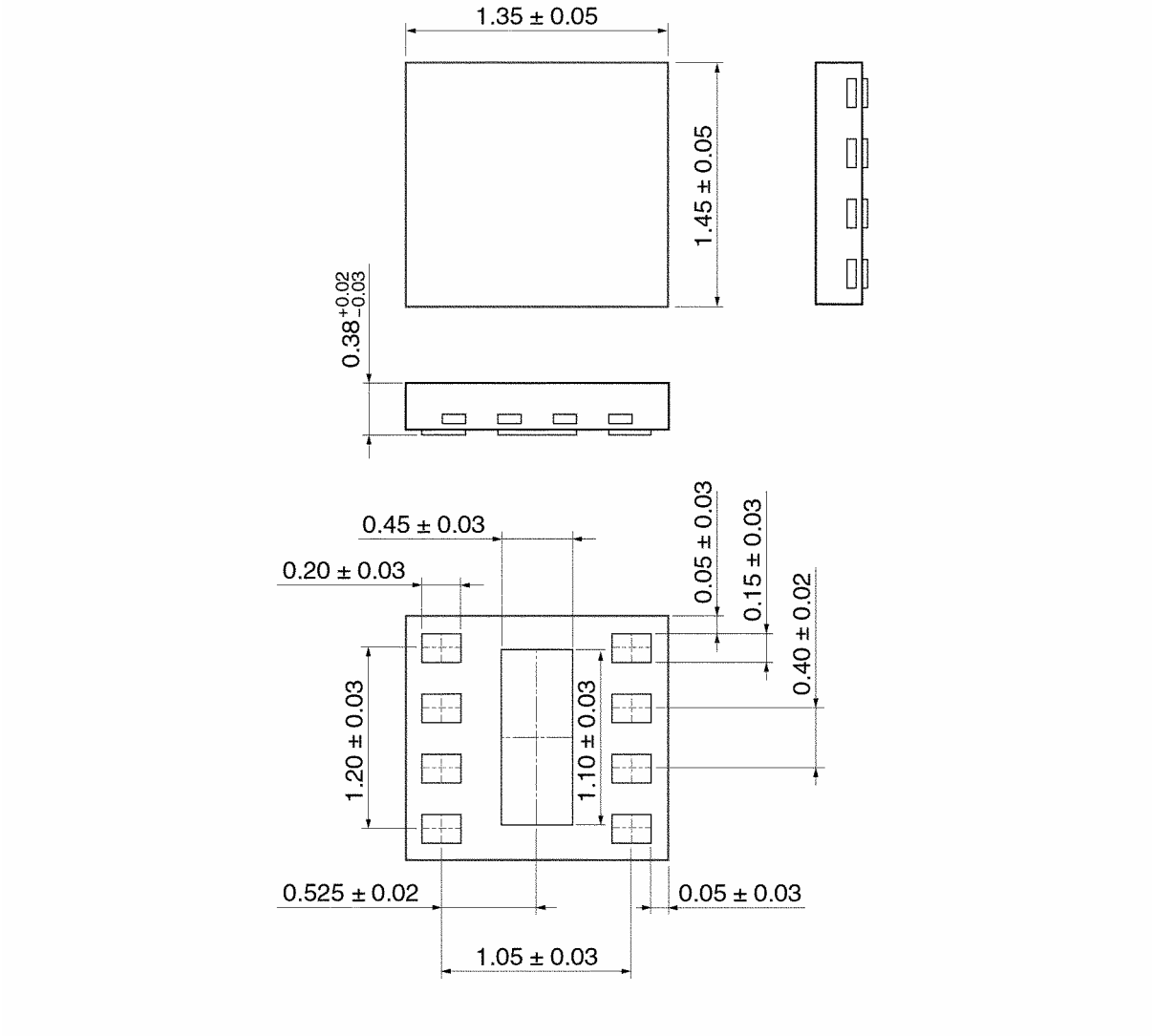



**Figure3 $t_{pLZ}$, $t_{pHZ}$, $t_{pZL}$, $t_{pZH}$**

| UNIT | $V_{CC}$ | | | | | |
|---|---|---|---|---|---|---|
| | 3.3±0.3 V | 2.5±0.2 V | 1.8±0.15 V | 1.5±0.1 V | 1.2±0.1 V | 0.9 V |
| $V_M$ | $V_{CC}$ / 2 | $V_{CC}$ / 2 | $V_{CC}$ / 2 | $V_{CC}$ / 2 | $V_{CC}$ / 2 | $V_{CC}$ / 2 |
| $V_X$ | $V_{OL}$ + 0.3 V | $V_{OL}$ + 0.15 V | $V_{OL}$ + 0.15 V | $V_{OL}$ + 0.1 V | $V_{OL}$ + 0.1 V | $V_{OL}$ + 0.1 V |
| $V_Y$ | $V_{OH}$ - 0.3 V | $V_{OH}$ - 0.15 V | $V_{OH}$ - 0.15 V | $V_{OH}$ - 0.1 V | $V_{OH}$ - 0.1 V | $V_{OH}$ - 0.1 V |

## Package Dimensions

CSON8-P-0.4 Unit: mm




Weight : 0.002 g (Typ.)

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20070701-EN GENERAL

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